



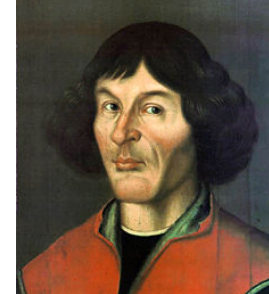
GMES/KOPERNIKUS

From EU Core Service to National Downstream Service

Erik Liljas

SMHI

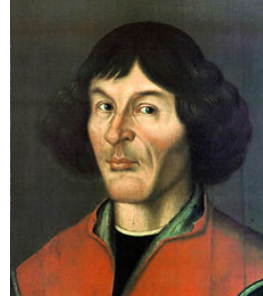
From EU Core Service to National Downstream Service



- ◆ **Basic GMES**
- ◆ **The European Meteorological Infrastructure (EMI) and GMES**
- ◆ **SMHI in the build up of GMES Core Services**
- ◆ **Nordic/Baltic Core Services – A sustainable infrastructure for climate, environment and safety issues in Northern Europe.**
- ◆ **Seatrack Web - Web based operational service – Downstream Service (Cecilia Ambjörn)**

GMES/KOPERNIKUS

Basic



◆ 1. Build-up phase:

Development of first generation of Sentinels, ground segment, data access, early operations: approx. 2.4 Billion Euro

◆ Financing – ESA (2005-2013)

M€ 758 Segment 1 (2005, 2007)

M€ 700-900 Segment 2 (2008)

◆ Financing – EC (2007-2013)

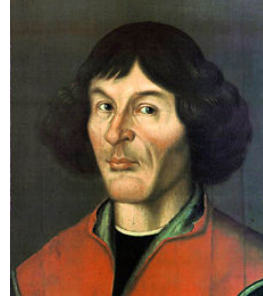
M€ 700-780 FP7 Space (2007-2013)

◆ 2. Operational Programme (2014-2023):

Development of recurrent Sentinel satellites, operational access to Member States / EUMETSAT missions, routine operations, evolution of Ground Segment Component: approx. 2.0 to 2.5 Billion Euro (details TBC)

GMES/KOPERNIKUS

Basic



◆ Contributions via EU + ESA

B€ 2,4 (Build-up)

B€ 2,0 to 2,5 (Operational Programme)

◆ National contributions + EUMETSAT, ECMWF (indispensable infrastructure for GMES services)

B€ 2,0 to 4,0

In total B€ 7- 8 = 80 B SEK

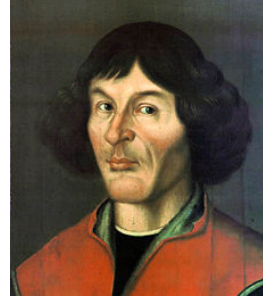
◆ Suppose Sweden invests 2½ % (GNI-part) ~ 2 B SEK over 20 years

These taxpayers' money should be transformed to societal and common benefits in Sweden and in Europe.

What can SMHI do?

GMES/KOPERNIKUS

Basic



◆ Core services – Pan-European, multi-purpose information service capacity

- Linked to EU information needs (EU policies and international commitments) or to decisions to share capacities at EU level
- Sustained public funding (EU & Member States)
- Freely available

◆ Downstream services – Tailored for specific applications at local, regional, national, European levels (public good or private use)

- Use core services as one of the inputs
- EU not directly driving the service and not responsible for service requirements
- EU should encourage / support the implementation of this service layer, e.g. through R&D funding
- EU not involved in Downstream Service governance & operational funding

Huge investment in new instruments: ESA, EU, Japan, Kina, Canada

New operational system for the surface network built on existing

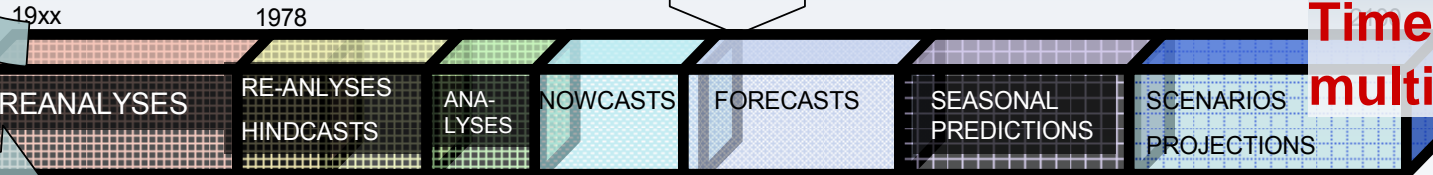
EEA, WMO, EUMETNET, etc.



Modelling/processing Toolbox

DATA ASSIMILATION - VALIDATION - POST PROCESSING

Dimensions:
Time, space,
multidisciplinary



CS

Supplementary data with space, time and multi-disciplinary coverage (Atm&Marine&Land Core Services, etc)

Down-stream Services' Toolbox

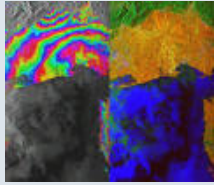
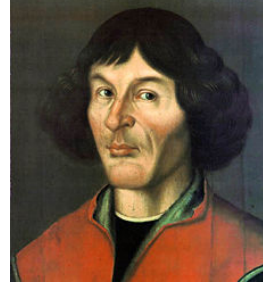
POSTPROCESSING, INTEGRATION IN FURTHER PROCESSING, MANUFACTURING, etc.

DS

USERS, DECISION-MAKING

Feedback Requirements

GMES/KOPERNIKUS specific missions: Sentinels



Sentinel 1 – SAR imaging

All weather, day/night applications, interferometry
(Oil Spill)

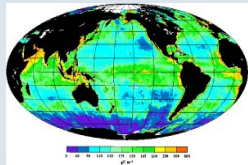
Launch
2011



Sentinel 2 – Multispectral imaging

Land applications: urban, forest, agriculture, etc Continuity of Landsat,
“SPOT follow on data”

Launch
2012



Sentinel 3 – Ocean and global land monitoring

Wide-swath ocean color, vegetation, sea/land surface temperature, altimetry

Launch
2012



Sentinel 4 – Geostationary atmospheric

Atmospheric composition monitoring, trans-boundary pollution

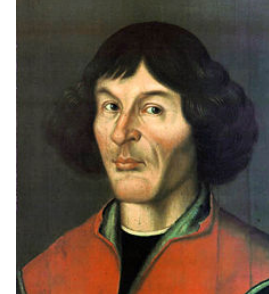
Launch
2017+

Sentinel 5 – Low-orbit atmospheric

Atmospheric composition monitoring

Launch
2018+

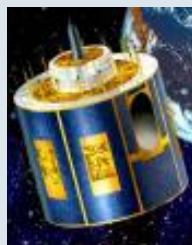
GMES/KOPERNIKUS Space Component: a Joint Infrastructure



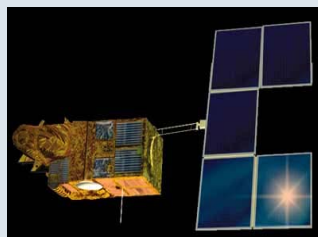
National, Eumetsat and international Missions for GMES (list non exhaustive)



METOP



MSG



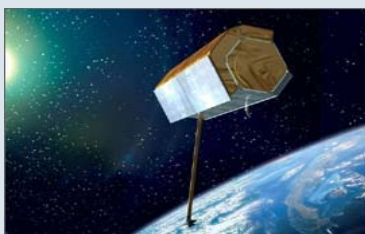
SPOT



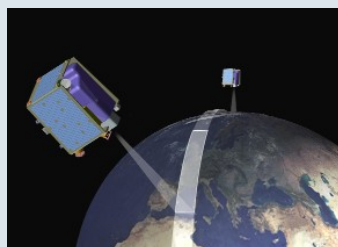
Jason



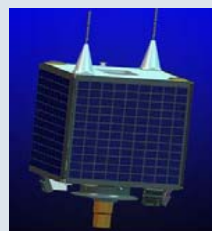
Radarsat



Terrasar-X



Rapideye



DMCs



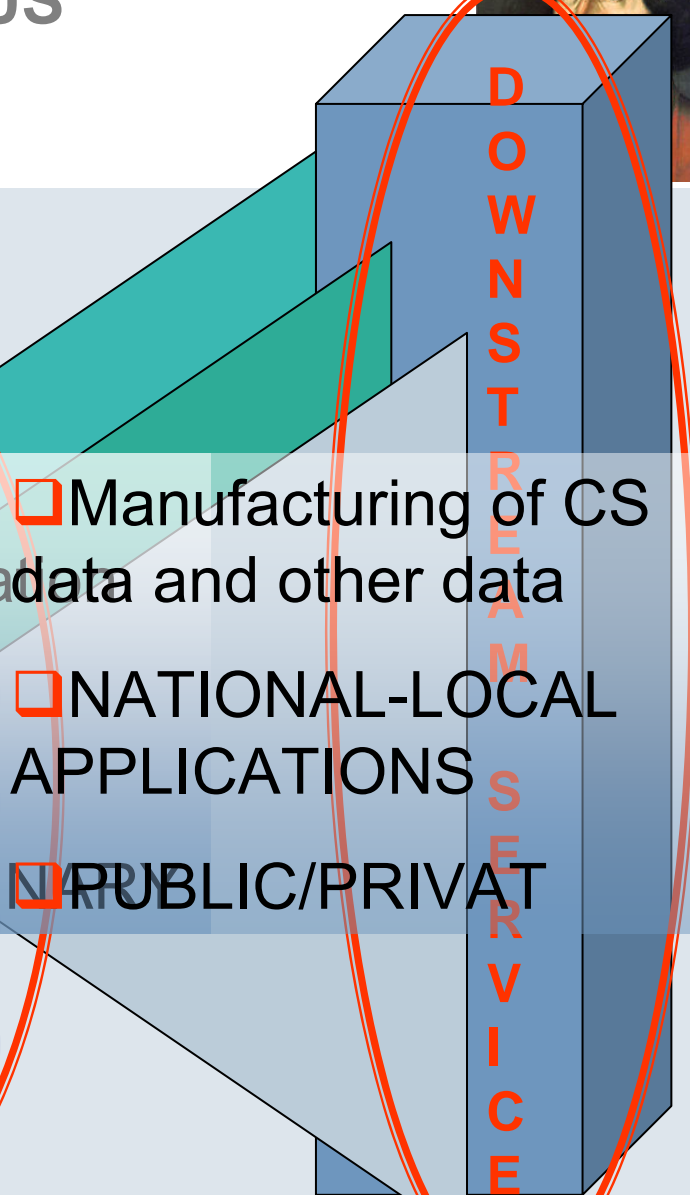
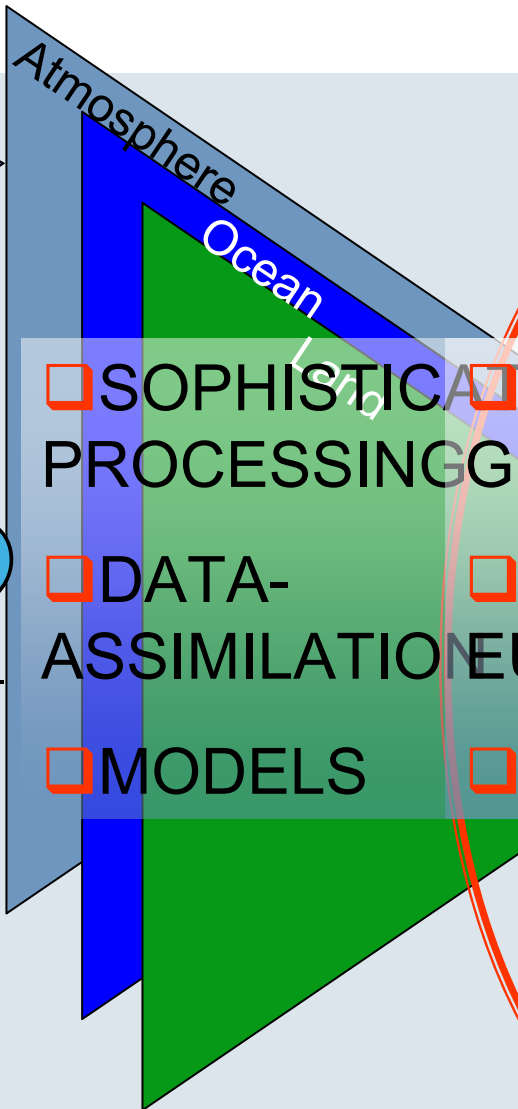
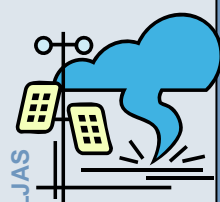
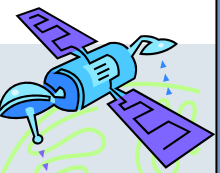
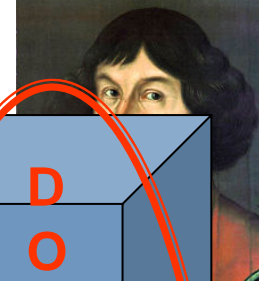
CosmoSkymed



Pleiades

**+ GOSAT, OCO, NPOES, GOES, Seosat, Tandem-X,
Enmap, Venus, Altika, etc.**

GMES/KOPERNIKUS Basic

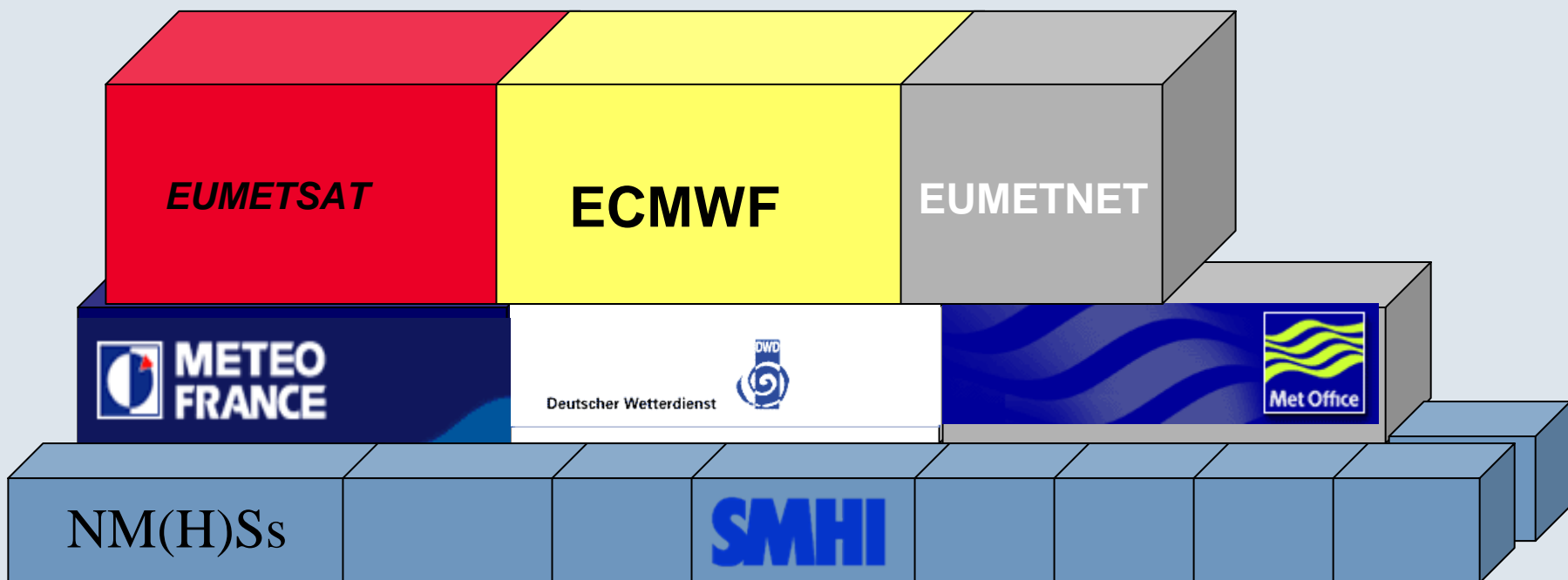
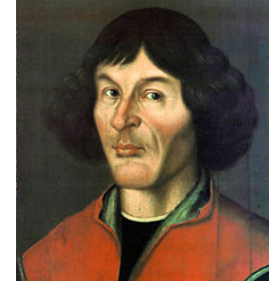


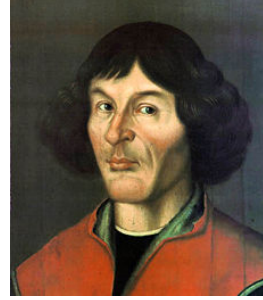
- SOPHISTICATED DATA-PROCESSING MODELS
- SPATIAL or GRIDDED information
- Manufacturing of CS data and other data
- GLOBAL-EUROPEAN MULTIDISCIPLINARY MODELS
- NATIONAL-LOCAL APPLICATIONS
- PUBLIC/PRIVATE

ERIK LILJAS

GMES/FA-1

GMES and The European Meteorological Infrastructure (EMI)



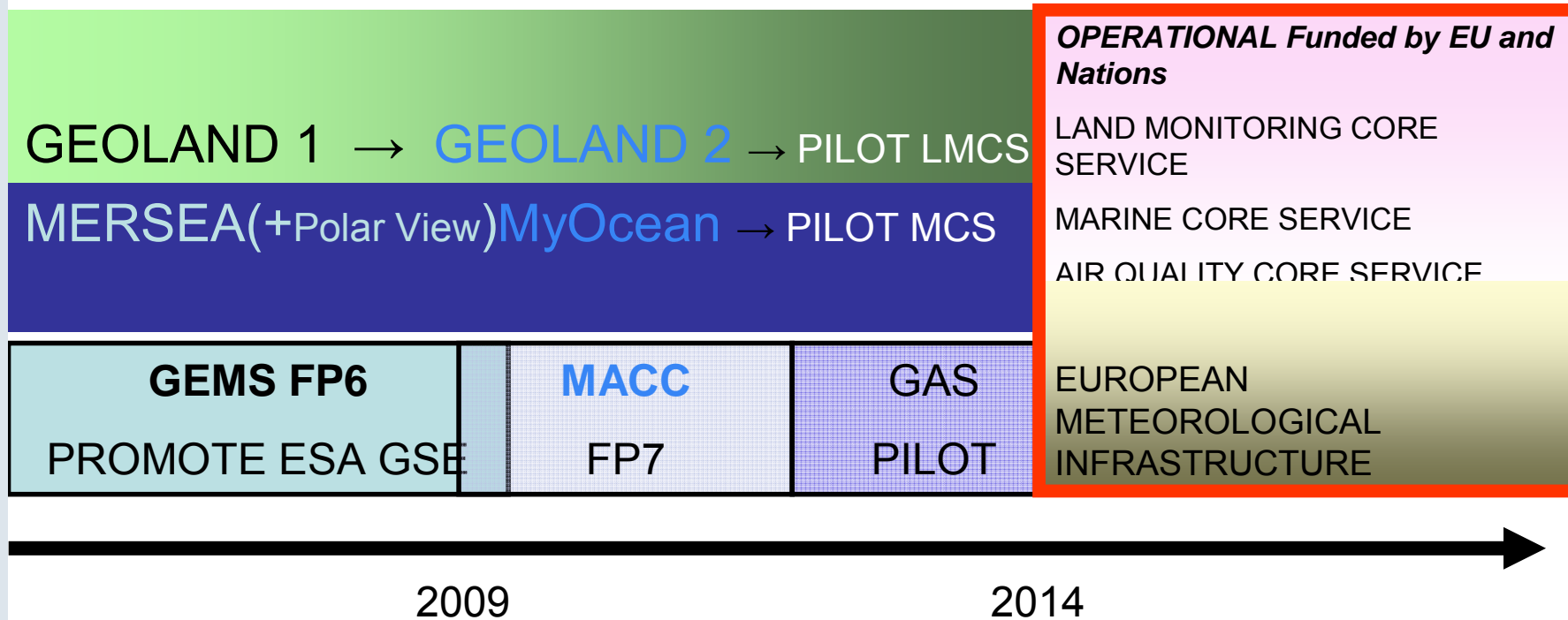


- ◆ EMI is already working as a GMES
 - ◆ ECMWF and NMHSs are providing
1. Currently EMI participates strongly in the development of GMES Core Services; LMCS, MCS and GACS
 2. EMI investments in European infrastructure is around B€ 55 over 30 years
 3. EMI is a fundament for GMES.

SMHI in the build up of GMES Core Services

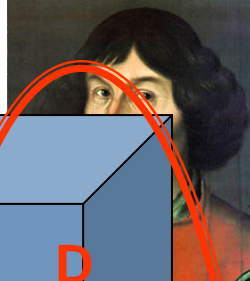
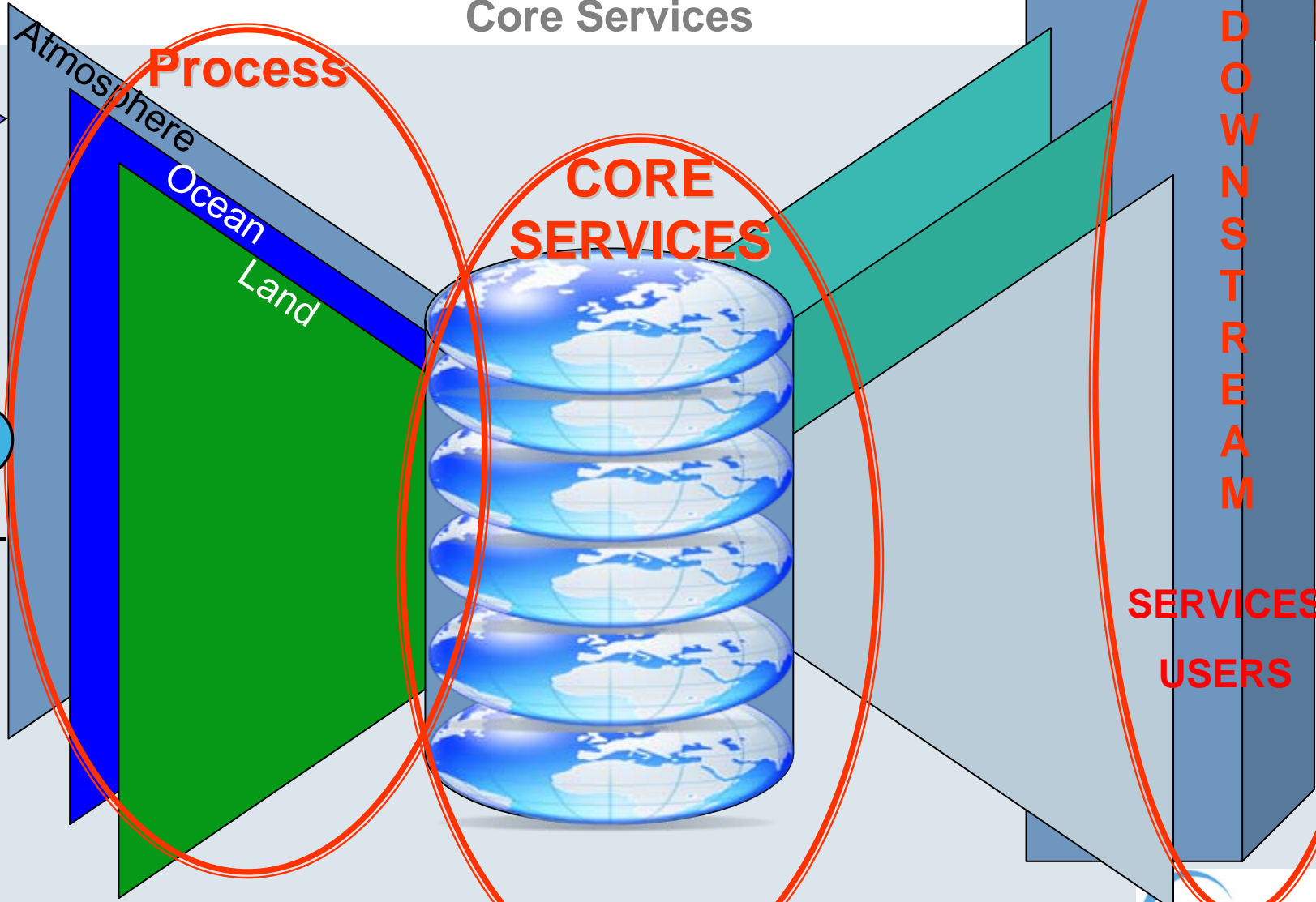
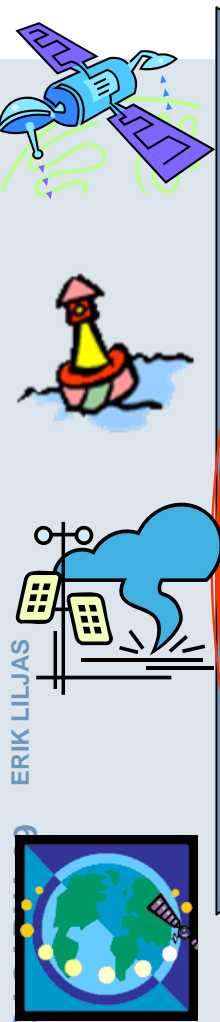


From ESA GSE and EU's FP6, FP7 project to operational services



MACC = Monitoring Atmospheric Composition & Climate (ECMWF)

Role in Atmosphere, Marine, Land Monitoring Core Services



SMHI in the build up of GMES Core Services



MACC

ECMWF (Integrated Forecast System)

- Global Analyses

- Global Forecasts

- Some of the required satellite data retrievals

SMHI (MATCH)

- Regional Analyses

- Regional Forecasts

Historic Analyses

- Current situation

- Forecast

- O₃, PM₁₀, NO₂, SO₂

- Projections

- Estimates of global forcing, emissions

- Specific services for ozone, solar and UV radiation

DOWNSTREAM

- Local Forecasts, Warnings

- Ground Level Ozone, etc.(AQ)

- UV radiation

- Planning; Cities, Regions

- Input to eco-systems (The Baltic Sea)

- Monitoring of International, European and national convention, policies, etc.

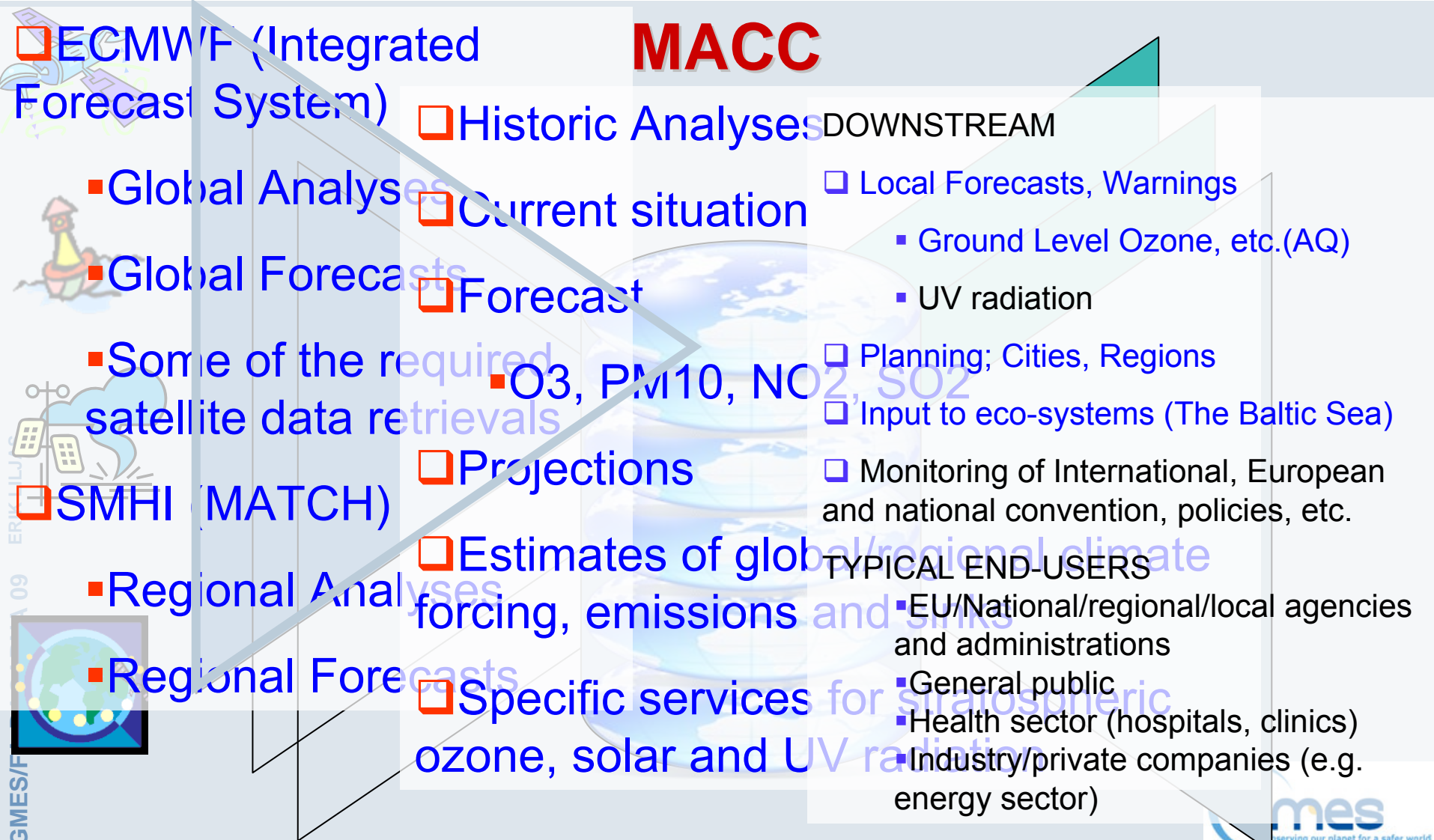
TYPICAL END-USERS

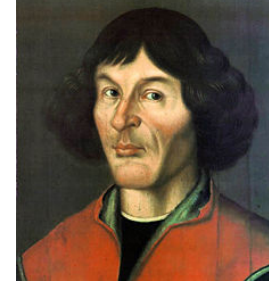
- EU/National/regional/local agencies and administrations

- General public

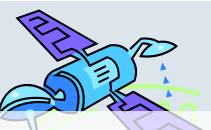
- Health sector (hospitals, clinics)

- Industry/private companies (e.g. energy sector)





GEOLAND-2

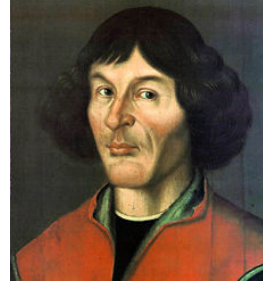


- Static & Historic data
 - Topography, soil (streams, rivers, lakes, DOWNSTREAM the sea)
 - Reanalyses (ECMWF)
 - Historical Run Off (GRDC)
- Updated data set
 - Generic Landcover (fr satellite: Sentinel 2, etc.)
 - Projections (SMHI, IPCC)
- Frequently updated, Forecasts
 - Water discharge
 - Bio-geophysical parameters (Climate Change Impact etc.)
 - Gridded meteorological data: prec., temp, snow
- SMHI HYPE (E-HYPE, Balt-HYPE)
 - Flow rate
 - Soil moisture
 - Nutrients
 - N & P
- Local Forecasts, Warnings
 - Flow, water level
- Planning; Cities, Regions
- Input to eco-systems (The Baltic Sea, coastal zone)

TYPICAL END-USERS

- EU/National/regional/local agencies and administrations
- General public
- Water authority sector
- Industry/private companies (e.g. energy sector, agriculture)

ERIK LILJEBLOM
GMES/F



MyOcean



ECMWF (IFS/OASIS3/NEEMO coupled system) Global atm. forcing



▪ Some of the required satellite data retrievals (Jason-2, -3, MetOp)

Mercator (Met Office)



▪ Global Dataassimilation/Analyses
▪ Global Forecasts

▪ Some of the required satellite data retrievals (Jason-2, -3, Sentinel 3)



SMHI (Measurements, HIROMB)

▪ Regional Dataassimilation/Analyses
▪ Regional Forecasts

Historic Anal

Current situa

Forecast

Projections

Estimates of

forcing, emissi

All as gridded data

DOWNSTREAM

Marine Safety

Oil Spill Service

Monitoring eco-systems (The Baltic Sea)

Etc. SH, ICE, etc.

TYPICAL END-USERS

▪ Marine Environment (EEA)

▪ Seasonal and weather forecasting, Climate

▪ Offshore

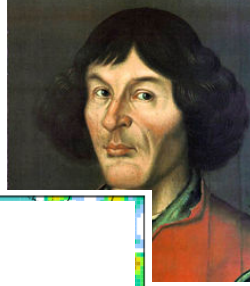
▪ Maritime transport and safety (EMSA)

▪ Fisheries

▪ Research

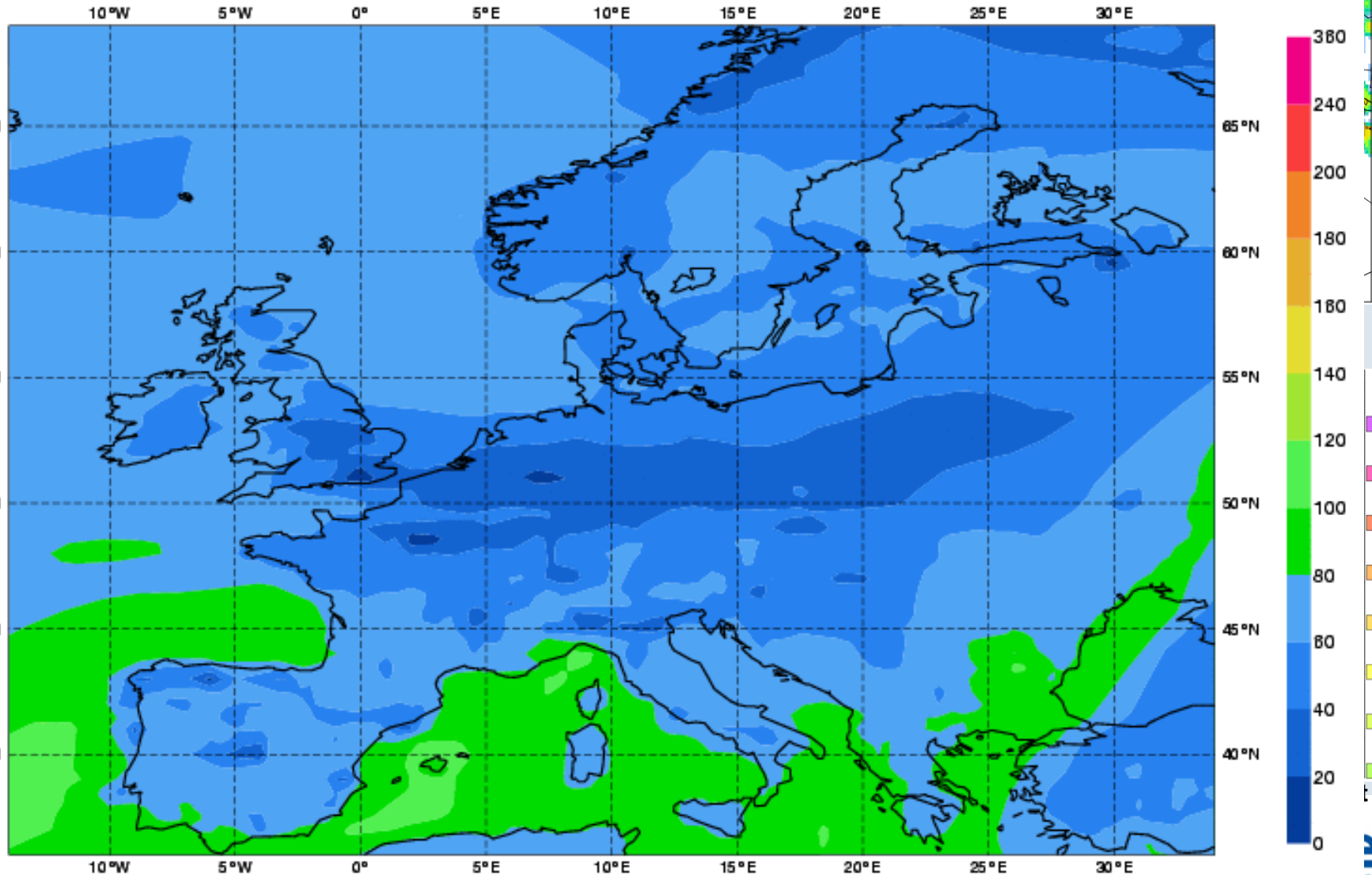
▪ General Public

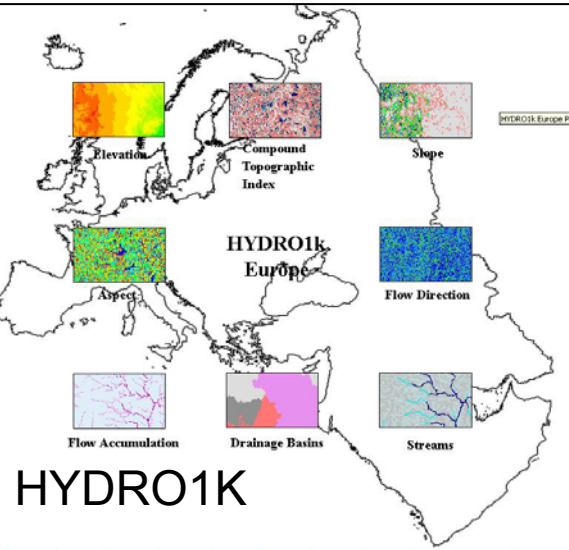
3D transport/chemistry/deposition model



Thursday 26 February 2009 00UTC GEMS-RAQ Forecast D+0 VT: Thursday 26 February 2009

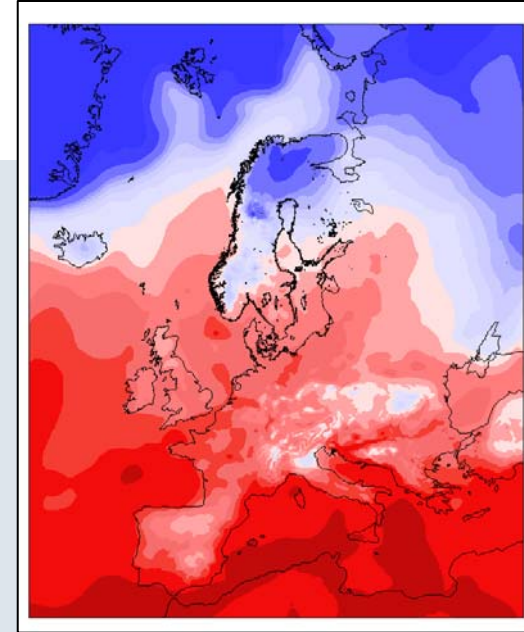
Model: MATCH Height level: Surface Parameter: Ozone Daily Mean [$\mu\text{g}/\text{m}^3$]





E-HYPE

- **Topography:** HYDRO1K
- **Land Use:** ECOCLIMAP, ESDB

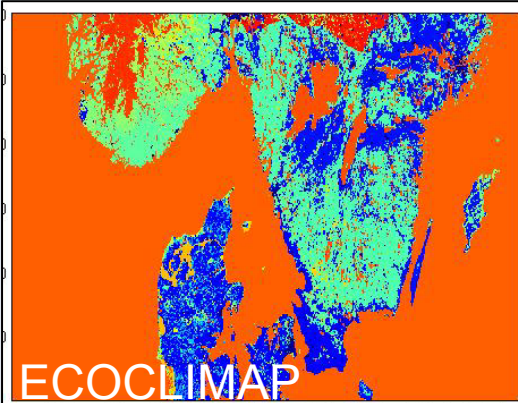


Meteorological forcing: ERAMESAN + ERAINTERIM
+ ECMWF(+synop data) + ECMWF

Observation of water flow: GRDC + BALTEX + EUROHARP

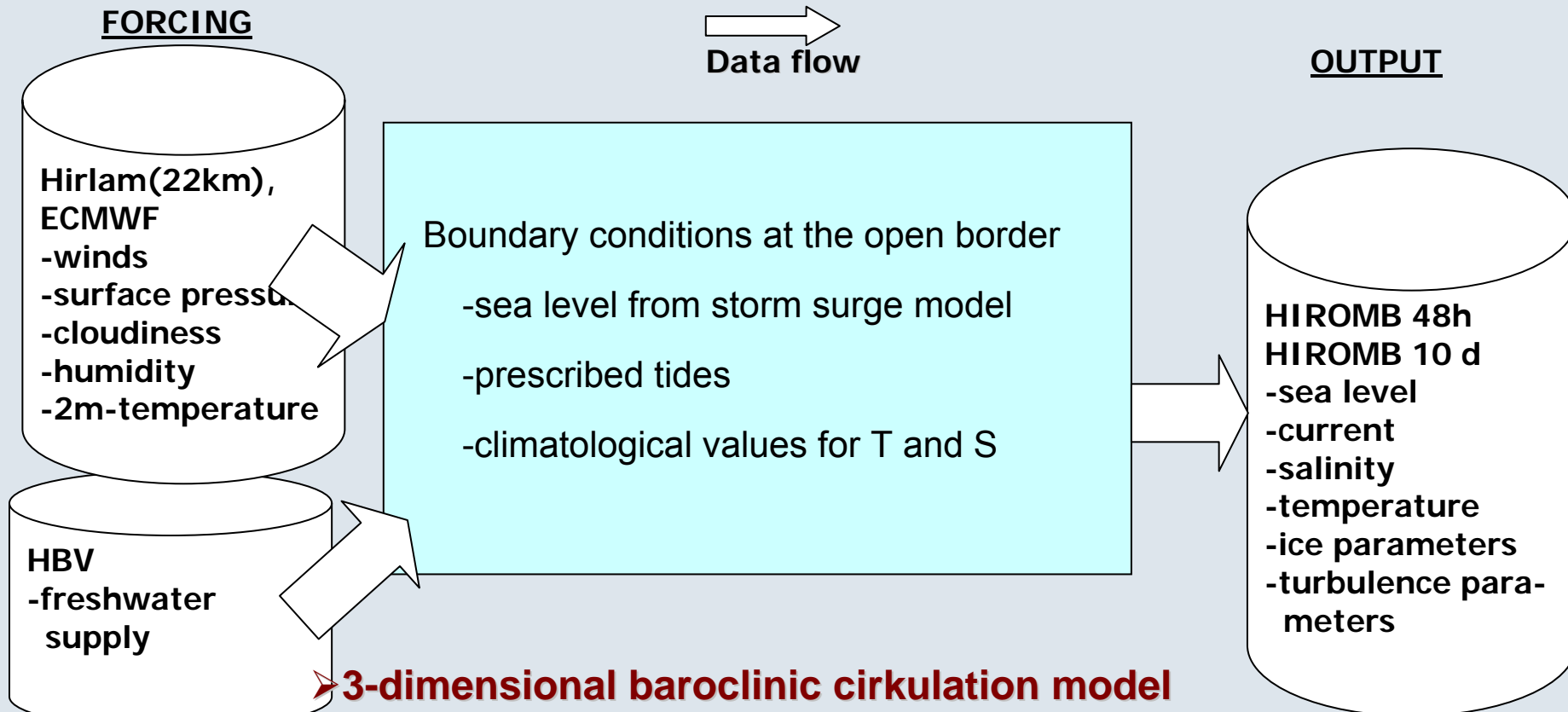
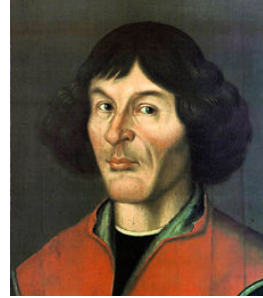
ERIK LILJAS

GMES/FA-DAGARNA 09



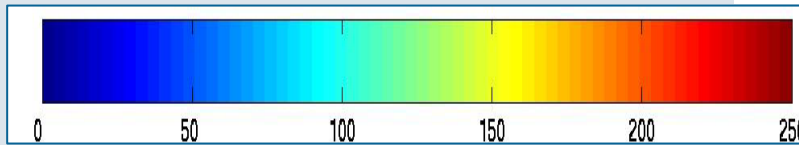
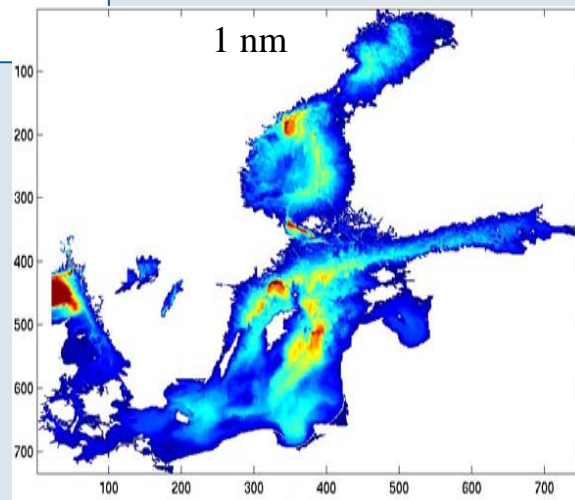
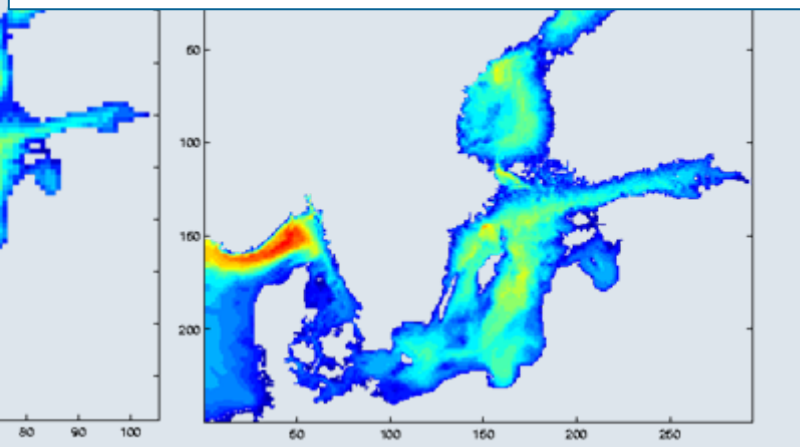
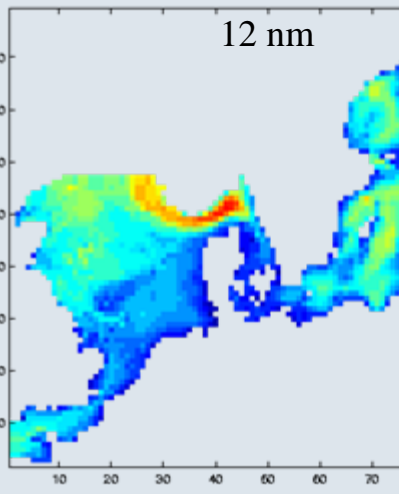
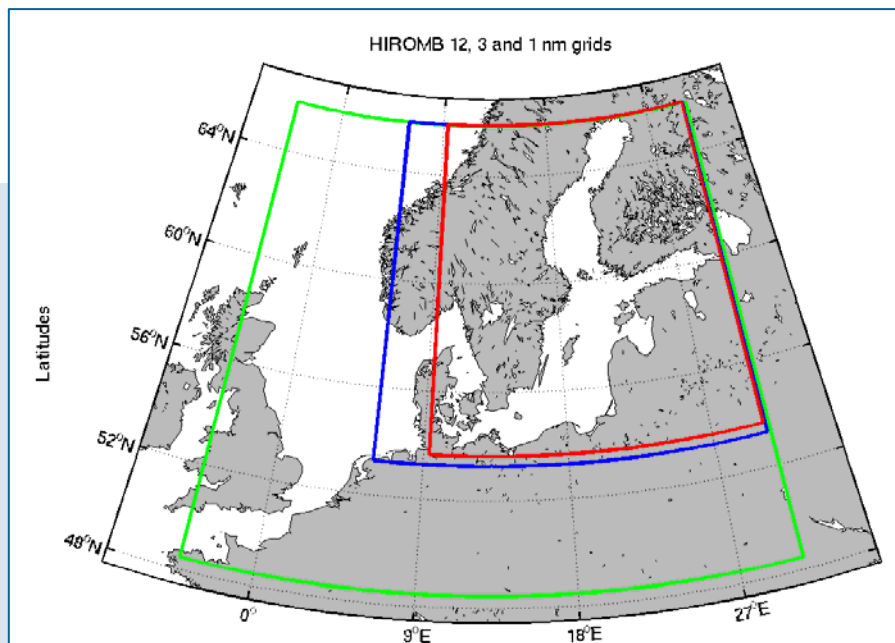
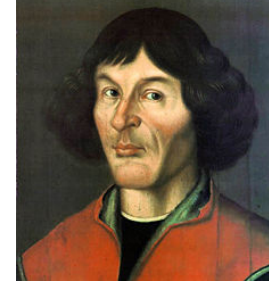
BALTEX
euro harp
GRDC

The Present HIROMB System (High Resolution Operational Model for the Baltic)



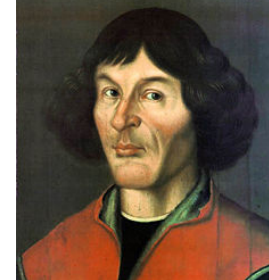
- **3-dimensional baroclinic circulation model**
- **Horizontal resolution 1x1nm, 3x3nm, (12x12nm)**
- **24 layers vertically (soon 50)**
- **1 nm run four times a day**
- **3 and 12 nm run four times a day**

Grid



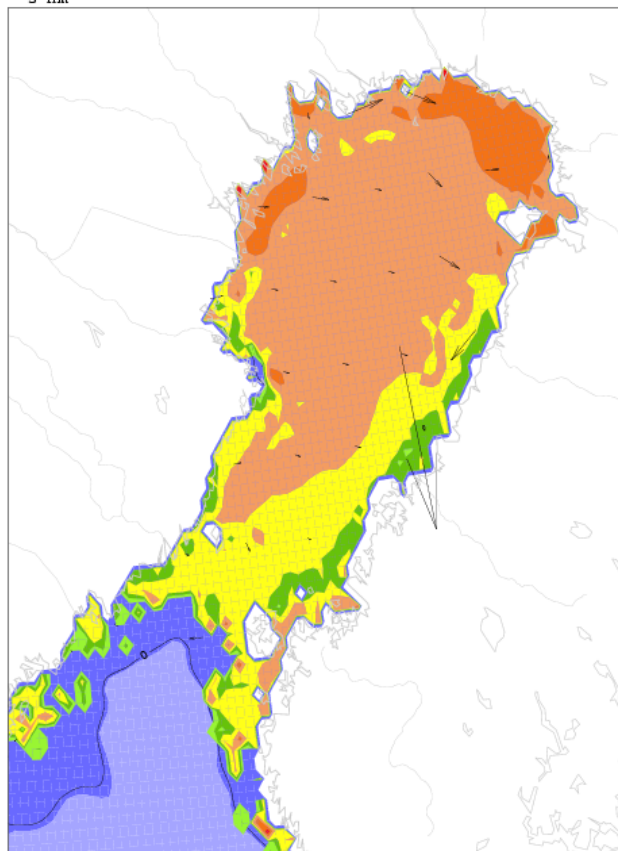
SMHI Polar View project site

<http://www.smhi.se/polarview/>

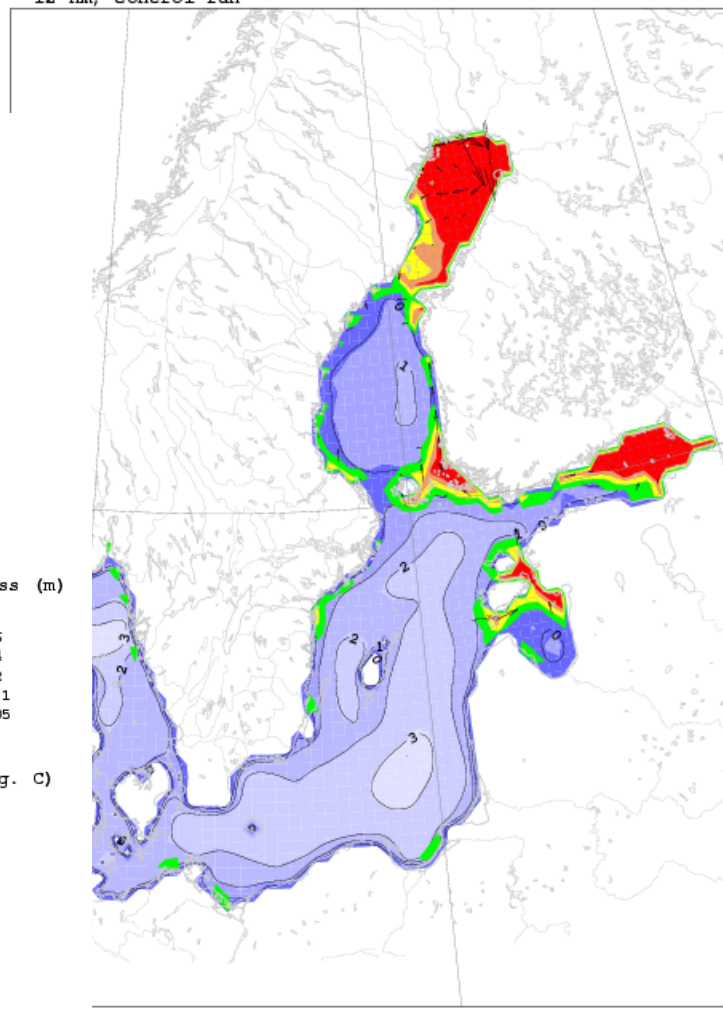


Level ice thickness, ice drift and SST

Level ice thickness, ice drift and SST
3 nm



Ice concentration, ice drift and SST
12 nm, control run

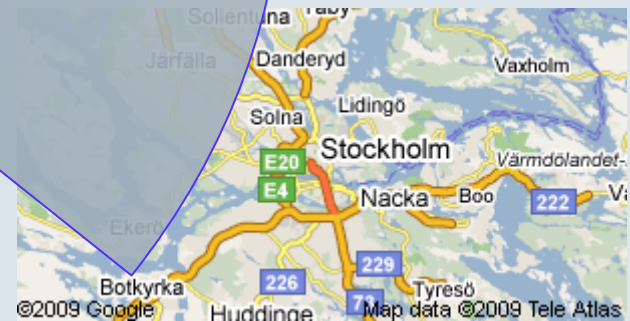
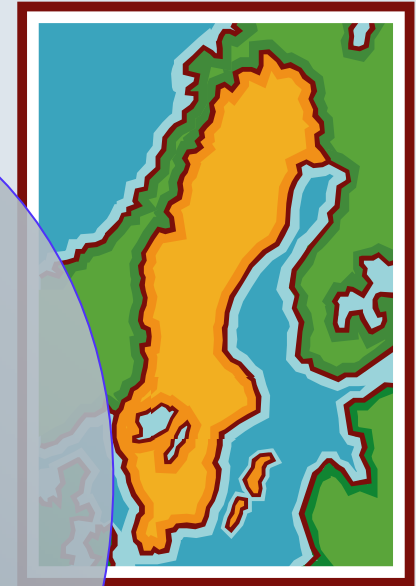
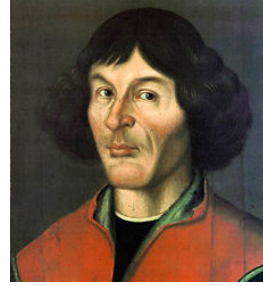


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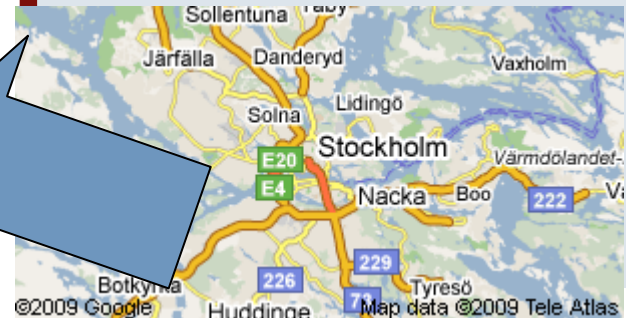
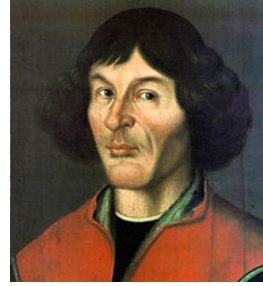
GMES/KOPERNIKUS

From a Swedish perspective

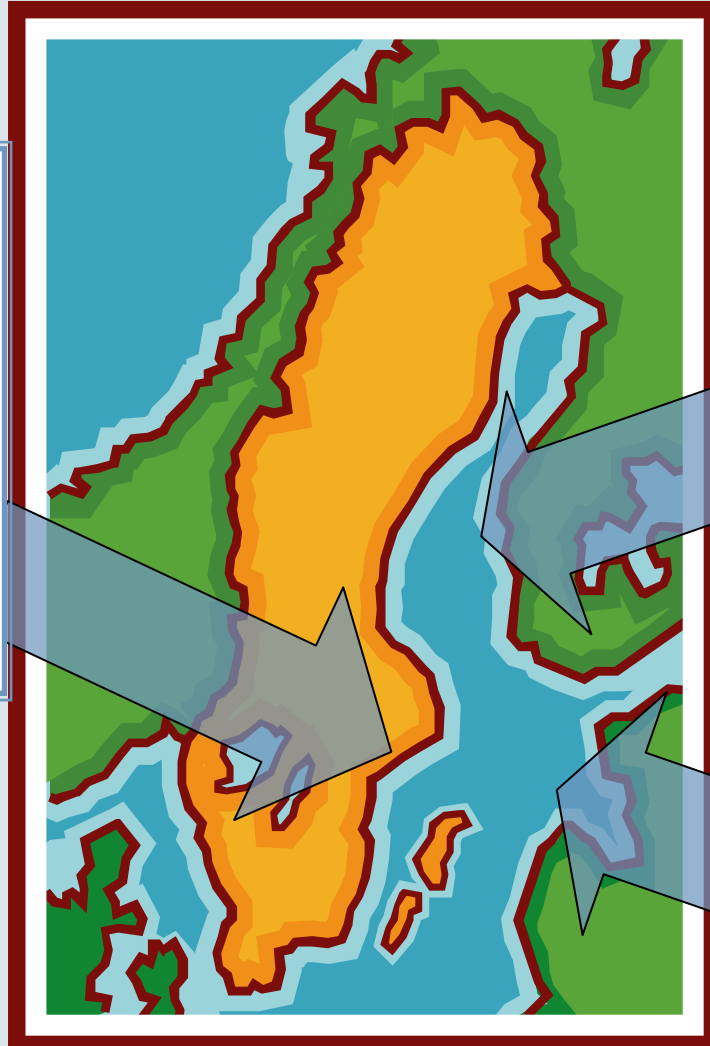
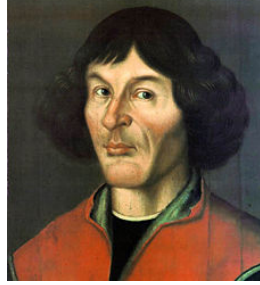


GMES/KOPERNIKUS

From a Swedish perspective



From a Swedish/Baltic perspective



**GMES
ATMOSPHERE
CORE SERVICE**

**SOURCES – SINKS –
TRANSPORT in the
AIR of POLLUTANTS**

**GMES MARIN CORE
SERVICE**

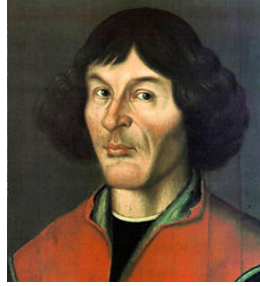
**SOURCES – SINKS -
TRANSPORT - PROCESSES – in
the SEA of
POLLUTANTS/NUTRIENTS**

**GMES LAND M CORE
SERVICE**

Baltic HYPE

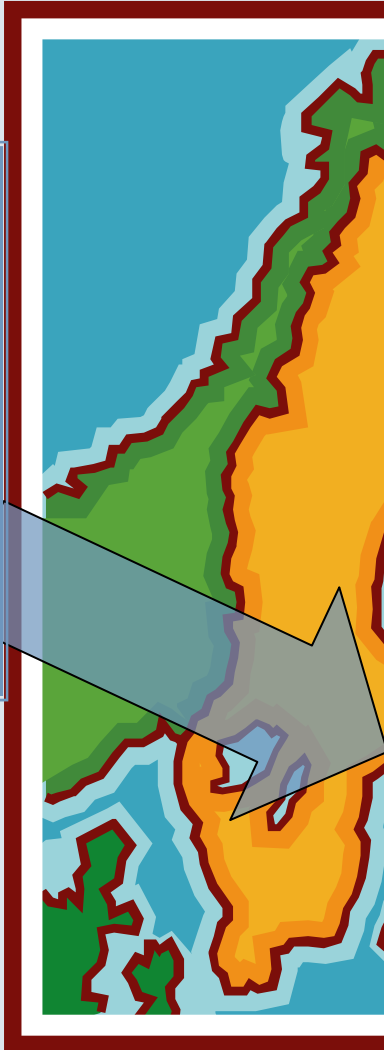
**SOURCES – SINKS –
TRANSPORT to the SEA of
POLLUTANTS/NUTRIENTS**

From a Swedish/Baltic perspective



GMES
ATMOSPHERE
CORE SERVICE

SOURCES – SINKS –
TRANSPORT in the
AIR of POLLUTANTS



AN EXAMPLE

GACS + MCS+ LMCS (+EMI)

ATTRIBUTES

SUSTAINABLE services

SPACE DIMENSIONS: Global ↔ coastal zone & stream catchment area

TIME DIMENSIONS: Climatology-Hindcasts-Current state- Forecast-Projections

COUPLING BETWEEN DISCIPLINES

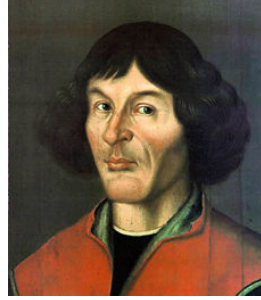
POLITICAL DIMENSION: All EU-participation

Public - Private

POLLUTANTS/NUTRIENTS

GMES/KOPERNIKUS

SMHI's role



◆ Contributions via EU + ESA

B€ 2,4 (Build-up)

B€ 2,0 to 2,5 (Operational Programme)

◆ National contributions + EUMETSAT, ECMWF (indispensable infrastructure for GMES services)

B€ 2,0 to 4,0

In total B€ 7- 8 = 80 B SEK

◆ Suppose Sweden invests 2½ % (GNI-part) ~ 2 B SEK over 20 years

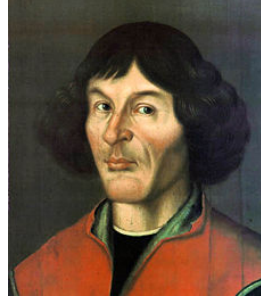
These taxpayers' money should be transformed to societal and common benefits in Sweden and in Europe

100 M SEK/Year for Sweden.

What can SMHI do?

GMES/KOPERNIKUS

SMHI's role



What can SMHI do?

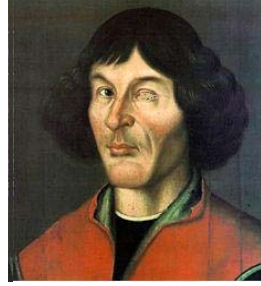
Investments and participation in

- the Core Service development
- the Downstream development

in the strategy by EUMETSAT, ECMWF and EUMETNET to take a broader responsibility within GMES

Through international collaboration SMHI is able to create more profit for Swedish taxpayers than through a restricted national one.

GMES/KOPERNIKUS SMHI's role



◆ We invest in an expensive and s
being prepared for take us into

◆ Are we ready
and a dri

